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LEEDS UNIVERSITY

A SHORT while ago we announced that Dr. D. T. A. Townend is to relinquish the Livesey Professorship at Leeds University—he has occupied the Chair since 1938—at the end of this month. He leaves the Fuel Department in a healthy state with a competent teaching staff covering probably a wider range of interlocked subjects than any other Department in British Universities; and we are well aware of the team spirit which has enabled the closest relations to be maintained with the Gas Industry. The critical problem at the moment is that of space in which to carry out the increasing work of the Department; every inch is occupied and it is to be hoped that the day is not far distant when new building schemes become practicable.

It may be recalled that in the report of the Heyworth Committee on the Gas Industry, reference was made to the endowment of the Livesey Chair as "an important step in meeting the need for specialized higher training" within the Industry. The Committee, however, then went on to point out the desirability of not describing the scientific qualifications required as "Gas Engineering," indicating that "there would seem to be no need for a narrow and specialized form of training; the Industry offers every scope in the widest sense for chemical technologists and chemical engineers, *and during a University course no advantage is to be gained by too great an insistence on the practical details of any one industry.*" The italics are ours. We think everyone would agree with the latter statement in general; indeed, it arises largely from evidence given to the Heyworth Committee. In view, however, of the fact that Leeds is at present the only School giving degrees in "Gas Engineering," the words underlined above were, we suggest, unfortunate. They might well convey the idea to those not too well informed that the Leeds training has been of this character. In fact, quite the contrary has been the case. The University has always insisted on dealing with the fundamental chemical engineering knowledge basic to Gas Engineering, and the practical affairs and developments within the Industry have always been dealt with in special courses of lectures given by experts from the Industry.

It has been during Dr. Townend's tenure of office that an extension of the activities of the Department has become possible so as to deal with the wider "unit processes" of the chemical engineering industry generally. This has not only been of advantage to the gas engineering students, but has met the demand within the University for a qualification providing for those who wish to enter the chemical industry at large; but for the Chemical Engineering degree a further year's study (four years in all) is required.

Largely with help from industry, the unit process equipment of the Department is being rapidly extended and it is hoped formally to open the temporary Chemical Engineering Laboratory before the end of the year. And we feel that what has been achieved under the difficult conditions of recent years will come as a surprise to many. Taking the field of chemical engineering as a whole, the basic chemical engineering training—the full training is closely in line with the suggestions of the Institution of Chemical Engineers—given to gas engineering students has been extended, and both the teaching staff and the facilities will go to make a school comparable with any. In the course of the next few years it seems certain that research progress in the wider field will be outstanding.

Much, of course, is owed to the friendship and practical encouragement of Mr. Charles Brotherton; he has provided four scholarships in Gas or Chemical Engineering, two members of the teaching staff, and £50,000 under a seven-year covenant towards Chemical Engineering equipment in a new building. Having also in mind the two United Kingdom Gas Corporation Scholarships, the two Institution of Gas Engineers Scholarships, and the Institution Gas Fellowship, Leeds provides a golden opportunity to men of scholarship standard.

THE ENCLOSED INTERMITTENT VERTICAL

THE intermittent vertical is characterized by the fact that, as with horizontal retorts and coke ovens, the retort is completely filled with raw coal at charging and completely voided of coke at discharging. A portion of the residual heat of the coke is utilized for gas-making by steaming for two or more hours after carbonization is complete but never enough to produce a cool discharge. Quenching with water has to be resorted to, with the attendant nuisance of wasted steam emission, unless one or other of the dry quenching systems is used in which the residual heat of the coke is applied to steam raising. Yet steaming in the retort after two hours is not particularly attractive because the quality of "added gas" falls off rapidly.

But the intermittent vertical has some qualities which make it an attractive proposition in some cases. The make per ton at the higher values, 500 and upward, is a little better, perhaps as much as 10%, than in the continuous retort. And the coke is denser; Thorman got cokes at Southall from Durham and Yorkshire coals considerably denser than those produced in continuous retorts in other works of the same undertaking and both decidedly stronger. The tar also is denser and more suitable for the direct production of road tars.

Two notable attempts have been made to combine these advantages with those of the continuous vertical, the great attraction of which is that it is a totally enclosed system from which coke is discharged cool and in which steaming is

continuous and readily and accurately controllable. Technically, both these attempts have, we understand, been completely successful. Messrs. W. Grogono and T. C. Finlayson described to the Institution in 1939 the Woodall-Duckham test installation at Croydon. This was followed by an important installation at Cambridge and we understand others are under construction. "The static vertical retort," as it is called, "consists fundamentally of an intermittently operated two-stage vertical carbonizing retort divided into two superimposed portions, the upper of which forms a coal carbonizing zone" heated externally, "while the lower portion forms a zone in which the coke is to a certain extent cooled," partly by steaming and partly by radiation to the surrounding atmosphere. At intervals which correspond with carbonizing period of 8 to 10 hours a pre-arranged portion of the coke is lowered from the retort proper to the cooling chamber, to which steam is admitted "in quantity at least sufficient to cool the coke down to an average temperature of 400°C. before it is discharged" with a minimum of 8% steam/coal. "By increasing the depth of residual hot coke left in the heated portion of the retort prior to refilling with coal, and by suitably raising the rate of steam admission, the coal throughput per day and the calorific value of the gas can be reduced and the thermal yield per ton increased without prolonging the carbonizing time and without reduction of volumetric gas output."

The "Westvertical" of West's Gas Improvement Company is the other example. The installation at St. Albans has been described in the "Journal." In this system the carbonizing chamber is referred to as consisting of three zones, the uppermost into which the fresh charge is introduced being the "carbonization zone," the lowest which is external to the setting being the "cooling zone," while a short intermediate zone mainly within the setting is the seat of the water-gas reaction. At the end of the carbonizing period, which is of the usual order of 10 to 12 hours, the hot coke is dropped into the bottom zone and a fresh charge introduced. Steam (and radiation) cools the coke below as carbonization proceeds above and by the time the latter is complete the coke is cooled to "black-heat" for discharge.

The results in the two systems are not dissimilar. First, as to gas-making, Mr. T. C. Battersby gave a set of graphs, comparable with those of Davidson's "Studies in Carbonization," in which he traces the composition and calorific value of the gas throughout a 10-hour period, the amount of steam being limited to 10% by weight of coal "added continuously at a steady rate throughout the carbonizing period." Messrs. Grogono and Finlayson state that at 500 B.Th.U/cu.ft. their "static vertical" will produce, from Durham coals, 87 therms against 82 in the ordinary intermittent vertical and 78 in the continuous, and Mr. Battersby's results with Yorkshire coals support the acceptance of these figures as a fair comparison.

LESSONS FROM EXPERIENCE

SIX and a half years' experience at St. Albans showed that the yields per ton of coal carbonized anticipated from the trial plant at Albion Ironworks had been consistently maintained under works conditions, and the operating costs were within the estimates. Maintenance charges were inflated by the cost of developments inseparable from a new system, but the experience gained here has led to modifications which will no doubt solve the problems involved. "The development of this plant," wrote Mr. Battersby, "is an excellent example of the goodwill which exists between the Industry and plant constructors," and no doubt the same is true of the plant at Cambridge. "As the older systems of carbonizing have had their difficulties, so this new development in carbonization has brought its peculiar problems, some of which have only become apparent and shown their full significance after an extended period of operation."

Another lesson to be learned from experience with these plants is the great length of time which must be expended before pioneering efforts of this kind can be brought to fruition, a length of time which has, of course, been stretched by the difficulties of the war years. The original patents date back to 1930 when full-scale pilot plants were already in being. We thus have a period of at least 16 years and perfection, even of the practical standard, is not yet claimed. And even allowing for war-time delays we suggest that this gives some measure of the length of time which is required for anything like a major change in methods of gas-making.

Whether the enclosed intermittent is destined (in Mr. Battersby's words) to become ultimately an established method of carbonizing even in the larger works is open to question. It represents only one line along which inventive minds are working. But that it is a form of plant which merits serious consideration in the design of the modern gas-works is beyond question.

Personal

Mr. A. PREECE, Senior Lecturer in Metallurgy in the Fuel Department at Leeds University, has been appointed to a Readership in this subject.

* * *

Mr. ROBERT CECIL WARDELL, Engineer and Manager of Boston Gas Light and Coke Company, was married to Miss Sheila Mary Harding, of Doncaster, on Sept. 4.

* * *

Mr. S. WATERHOUSE, Secretary of Melton Mowbray and Uppingham Gas Undertakings, has retired after 25 years' service. Mr. G. H. Stanley, of Stroud, has been appointed to succeed Mr. Waterhouse.

* * *

Mr. A. BELL, formerly Distribution Superintendent of the Exeter Gaslight and Coke Company, has been appointed Distribution Superintendent of the Rochester, Chatham, and Gillingham Gas Company. Mr. Bell was President of the Western Juniors from 1938-1943.

* * *

Mr. J. WINSON SCOTT has recently retired from the firm of R. & J. Dempster, Ltd., and a few days ago was the recipient of a present made to him on behalf of the Management and Staff of the firm in order to mark his retirement and, at the same time, show the affection with which he is regarded by his former colleagues. Mr. Scott's active association with the Gas Industry started when he was very young, and he was the first articled pupil of Dempsters. He is the sole survivor of all those who were actively associated with the Dempster undertaking in the days before 1885, when the firm was established at Gas Plant Works, Manchester. Mr. Scott joined the Board of Directors in 1925 and was for many years the senior outside representative. He was a well-known figure in gas engineering circles in most parts of the British Isles and in the Colonies also, and regularly attended the various Gas Association meetings. An able engineer, possessed of many original ideas, he has been closely associated with many of the Dempster patents. Mr. and Mrs. Scott celebrated their golden wedding in 1938. Mr. Scott's youngest surviving son (Mr. Walter W. Scott) is the present Manager of the London Branch Office of the firm.

Obituary

Chairman of the Board of Directors of Stamford and St. Martin's Gas Light and Coke Company since 1939, when he succeeded his brother, the late Mr. E. Dalton, Mr. CHARLES DALTON has died aged 78. He was appointed Vice-Chairman in 1934.

* * *

The death has occurred at the early age of 38 years of Mr. WALTER SMITH, Area Superintendent of the Pudsey/Morley area of the West Riding Group of Gas Companies. Mr. Smith, a Manchester man, who went to the Pudsey Company from Whitby in 1940, received his training with the Stretford Gas Board.

* * *

Mr. ROWLAND FISHER, for 40 years Resident Manager of the Litchurch Works of the Derby Gas Light and Coke Company, has died aged 79. He joined the Company in 1889 and retired in 1937. His grandfather, the late Mr. Isaac Fisher, was a founder of the Company, and was Secretary until he retired at the age of 92.

Letter to the Editor

Aerated Burners of High Stability

DEAR SIR,—Mr. Zollikofer is, of course, one of the pioneers of the self-extinguishing injector burner and I am very interested indeed in his remarks. It is surprising to learn that this type of injector is compulsory on all appliances which are eligible for the Swiss national approval seal—although I am an enthusiast for them myself, I should have thought there would always have been cases where the advantage gained was not worth the additional cost. Furthermore, unless the double injector principle is used there tends to be a falling off in aeration and I notice Mr. Zollikofer mentions 2: 1, which would be low by our standards for, say, a gas fire, unless the C.V. of the gas be 400 or less. In this connexion it is of interest that in a recent Paper given to the Association Technique du Gaz en France M. Cure describes fully-aerated low pressure burners which have self-extinguishing injectors.

As Mr. Zollikofer says, a conical rather than a cylindrical jet is needed for the type of injector he has described. It is not, however, essential, and a great many injectors which employ cylindrical shaped jets are in use to-day and can be relied upon to maintain their self-extinguishing properties.

Yours truly,

L. T. MINCHIN.

25a, Thurlow Road,
N.W.3.
Sept. 12, 1946.

Gas and the Coming Winter

Last week, in a Press interview, Mr. J. R. W. Alexander, General Manager of the British Gas Council, said: The risk of interrupted gas supplies during the coming winter are greater in some areas than others and not necessarily for the same reasons. There is a serious overall shortage of coal and that allocated to the Gas Industry is frequently not suitable for gas making purposes, which results in plant not being used efficiently or to capacity.

In most undertakings these difficulties are increased by reason of gas-works plant not being adequate to meet the demand. Not only has it been impossible, owing to shortages of labour and materials, to complete much needed extensions, but during the last seven years it has been impracticable fully to maintain and repair plant and so keep it in good condition. Such difficulties are particularly acute in undertakings which experienced extensive war damage. The wear and tear on gas making plant, which operates 24 hours a day throughout the year, is heavy.

The Gas Industry has used every effort to overcome these difficulties and will continue to do so, realizing that any failure in the supply of gas to its domestic, industrial, and commercial consumers can have a serious effect upon the life of the community, as was realized during the war when the Industry was able, paradoxically enough, to meet the demands made upon it. But the Industry is informed that quantities of coal necessary to secure reasonably adequate stocks are not and will be unlikely to become available, that the allocation of suitable coals cannot be generally arranged, and that the repair, maintenance, and extension of plant cannot be expedited beyond a certain point, owing to the Government's building commitments and the shortages of labour and materials.

The demand for gas has increased appreciably since the outbreak of war and shows no signs of diminishing. The public has more money to spend on maintaining more satisfactory standards of heating, cooking, and hot water supply; the shortage of domestic staff discourages the use of solid fuel; and consumers are disposed to use gas, which is uncontrolled, and so conserve coal and coke which are rationed. The extensive use of labour-saving gas appliances in the building of new and the conversion of old houses continually adds to the demand for gas, while the existing and new needs of industry, anxious to take advantage of a fuel which can be so efficiently applied and controlled, cannot immediately be met in all cases.

There continues to be a shortage of personnel in every section of the Industry, especially of skilled men, many of whom need specialized training and experience to discharge their duties properly. In a few isolated instances there have been strikes, although the Gas Industry has an unequalled record in the harmony of its relationship with its employees.

It is necessary again to emphasize that the circumstances vary considerably throughout the country and even in London. While the possibility of interrupted supplies is appreciable in some undertakings—especially if prolonged cold weather is experienced or there is any breakdown in plant or the supply of coal—in others there is every reason to hope that the demand will be met, especially if consumers will avoid wasting gas and endeavour to minimize its use at the peak periods.

It is the intention of the British Gas Council, in collaboration with the Ministry of Fuel and Power, to draw the personal attention of gas consumers to the situation, to seek their co-operation, and to afford them instructions as to the care of appliances and their economic operation.

Gas Rationing

Mr. Alexander, in a further interview, said: The overall rationing of gas is to be deprecated and has not been suggested by the Ministry of Fuel and Power to the British Gas Council. Elaborate arrangements were on more than one occasion made during the war for the introduction of gas rationing, but the schemes were abandoned as impracticable. It is almost impossible fairly and effectively to ration a fuel obtainable by the turning of a tap and the consumption of which cannot be checked until the meter is read, when remedial measures, even if in time, are difficult to apply.

Overall rationing is not at present necessary, owing to the variation in coal stocks and plant conditions in the undertakings throughout the country. Moreover, every effort should be made to avoid the drastic method of rationing, since the public is entitled to less rather than more control of the essential commodities it needs. It would, in any event, be difficult effectively and equitably to ration gas at short notice, owing to the complexity of the arrangements which would have to be made, and no form of control would be more unpopular. Consumers' needs vary considerably and are affected by the type of house and appliances in use and temporary considerations such as illness. Presumably, too, gas rationing would have to be related to the individual consumer's stock or use of solid fuel, or the consumer relying entirely or mainly upon gas would be prejudiced.

If every effort is made to maintain the supplies of suitable gas making coal to gas undertakings and the utmost priority is given to the labour and materials necessary for plant repairs and extensions, and this is coupled with real economy on the part of consumers, gas undertakings have every hope of maintaining the supply or, if the worst comes in a particular district, of restricting to brief periods any reduction in pressure or interruption of supply.

The critical effect upon the life of the community of any overall breakdown in the supply of fuel cannot be over-emphasized. It has never been experienced, hence the difficulty of appreciating what would be involved and the result, not only upon the industrial, commercial and domestic life of the nation, but upon the moral of the people.

Give us the coal and plant and we will do the job! Contrary to what is in some places now being suggested, it is the Gas Industry's object to supply as much, not as little, gas and coke as it can. But the position is not secure with an average coal stock of 2.8 weeks' consumption, which in many cases means that an individual undertaking may only have a few days' supply on its works. Before the war six weeks' stock was held at the commencement of the winter season, but then any interruption in delivery was relatively speedily remedied.

Dunfermline Dean of Guild Court have approved the plans for the extension of the Corporation Gas-Works at a cost of £56,000.

The tender of Messrs. Drakes, Ltd., Halifax, has been accepted for the installation of an additional bed of retorts at Darwen Corporation Gas-Works.

Gas managements in the south of Scotland are faced with the prospect of a definitely lean period ahead. In Edinburgh the Gas Department has indicated that it is now carrying only a three-week stock of coal as against the normal 10-week stock, and that there is not a great chance of increased deliveries being made to allow any increase to the higher level.

Councillor W. Smith, Chairman of the Burnley Gas Committee, told the Town Council that proposed extensions at Oswald Street Gas-works, costing £239,450, would not eliminate the necessity of purchasing coke oven gas from the Lancashire Foundry Coke Co., Altham. Forty per cent. of Burnley's gas comes from Altham. They would still need that even when the extensions were completed.

Diary

Sept. 26.—Wales and Monmouthshire Association of Gas Engineers and Managers. General Meeting, Grand Pavilion, Porthcawl, 10.30 a.m.
Oct. 8.—British Gas Council, Gas Industry House, at 2.30 p.m.
Oct. 9.—Domestic Development Committee, Gas Industry House, 2.30 p.m.
Oct. 11.—National Federation of Gas Coke Associations: National Technical Committee, Gas Industry House, 10.30 a.m.
Oct. 11.—Solid Smokeless Fuels Federation Technical Committee, Gas Industry House, 2.30 p.m.
Oct. 21.—London and Counties Coke Association: Finance Committee, 10.30 a.m.; Executive Committee, 11 a.m.; Central Committee, 12 noon; Annual Luncheon, 1 p.m. for 1.15 p.m.; Annual General Meeting, 2.45 p.m. Grosvenor House, Park Lane, W.1.
Nov. 26-27.—Institution of Gas Engineers: Autumn Research Meeting.

Opening of De La Rue Gas Development's Factory

Minister of Supply's Praise for Enterprise

" We are hungry for goods—goods of the right kind, for the right purpose and in the right place," said Mr. JOHN WILMOT at the opening of the new De La Rue Gas Development's factory at Team Valley, Gateshead-on-Tyne, on Tuesday of last week.

Commending the enthusiasm and initiative shown by the Company in meeting the gas water heating requirements for the post-war low-cost housing programme, Mr. Wilmot said that the establishment of the factory would benefit the country as a whole.

" This benefit to the country as a whole will come not only from the production of gas water heaters, but also as a reflection of the prosperity which this part of the country thereby derives," said the Minister. " In addition to sound business reasons, the selection of the site was based upon national plans for the redevelopment of what were called ' Development Areas '." Stressing the importance of planning the location of industry and the need for placing the production of essential goods first, the Minister said that a system of *laissez-faire* would result in the industrial conditions of the 'thirties, " when whole industrial areas rotted away."

Remarking on the good relations that existed between the Ministry of Supply and the Company, Mr. Wilmot said: " Mr. Friedman—son of a noted father (Dr. Bernard Friedman)—the Managing Director, has been for 20 years associated with the Gas Industry. I am glad to say that relations between the Housing Division of the Ministry of Supply and the Company have always been excellent. The manner in which the Company have solved their many problems and progressed to the advanced stage they have now reached in this venture is abundant proof of their capabilities, and deserves every credit."

Mr. Wilmot indicated two " business reasons " that influenced the decision to open the factory in the Tyneside Development Area. He said: " The first is the existence of abundant labour power of high quality, and the second is the existence of a co-operative and go-ahead Council who have entered into all the plans of the Company with the greatest helpfulness and enthusiasm."

Mr. Wilmot said that the importance of the work undertaken by De La Rue could be estimated in the light of the fact that some four and a half million houses will be needed in this country within the first ten years of peace.

The Export Aspect

The importance of the Company's contribution to the export trade was also emphasized. " I am especially interested in the possibility that these appliances may obtain a wide sale abroad," said Mr. Wilmot. " They have indeed been designed with the Continental market in mind—particularly the European countries which were supplied before the war exclusively by German manufacturers. As some indication of the possible extent of such a market in Europe alone, it is known that the sales of gas water heaters of the type that will be manufactured here, and which were exported from Germany to other countries in Europe had, in 1938, reached about half a million pounds annually.

" There are also considerable possibilities of extending the field of exports to other countries, and it is known that a considerable demand exists in South America, South Africa, Australia and New Zealand."

Speaking later at a luncheon attended by the Mayor of Gateshead, the Lord Mayor and Lady Mayoress of Newcastle, and the Mayor and Mayoress of Tynemouth, Mr. Wilmot thanked Mr. Bernard Westall most cordially for the welcome that had been given to him. He further congratulated the De La Rue Company on the foresight, public spirit and enterprise they had shown, and wished them every success in the expansion of their venture.

Mr. Wilmot referred to " the inevitable red tape " and said that he realized that to some extent it did exist. He concluded: " Everything my Ministry can do shall be done to help you overcome initial difficulties and bottlenecks."

Mr. BERNARD WESTALL thanked the Minister for his attendance at the opening of the new factory.

Addressing his remarks to representatives of the municipal authorities present, Mr. Westall said that De La Rue, in Tyneside would be " good employers, good ratepayers and good companions."

The Tour of Inspection

Mr. Wilmot was accompanied on a tour of inspection by some 40 journalists, who had been invited by the Company to study at close quarters a plant that, in its first year of work, is expected to produce 40,000 gas water heating appliances. Subject to an adequate supply of labour and material it is anticipated that, within three years, this production figure will be increased to 180,000 units each year, involving the employment of some 1,500 people.

The magnitude of such an undertaking is borne out by the capacity of the factory itself. The premises were allocated to the Company under a special Board of Trade re-development scheme last January and extend over an area of about 120,000 square feet.

An impression of sheer size within the factory is heightened by the carefully designed and accessible layout of the machinery and equipment involved in the high-precision mass-production processes. In the course of its evolution into the finished product, the raw material takes a route that is striking in its apparent simplicity. The easy road from stores to machinery, from machinery and welding to assembly, from assembly to despatch, speaks of great care in the initial planning of the production system—a modern principle that has in recent years proved its value in the stress of war.

The use of automatic lathes in the machining section is an example of modern planning permitting the useful employment of a high proportion of unskilled labour. In this connexion it is interesting to note that, allowing for an adequate number of skilled maintenance fitters, about 80% of the factory's employees will be unskilled.

Quality of production is not sacrificed, however, in the interests of economy in time and labour. Characteristic of the whole plant layout are the inspection arrangements. Components pass directly from the machines to an inspection cage running the whole length of the machine shop. From here a close and central check is kept on all operations, with consequent simplification of the whole task of supervision. In addition to extensive examination at all stages of production, the heaters are submitted to a final critical survey at test stands before they are despatched.

Production Control

Considerable interest was shown by the visitors in the devices employed to reduce the complex problem of " production control " to manageable proportions. Of these, perhaps the control boards were the most striking. Displaying a multitude of coloured labels, these boards enable the production controller to see at a glance the precise state of progress at any point in the factory. It would be true to say, however, that the factor which contributes most to the successful direction of the whole plant is the ease of approach to any part of the " assembly line."

A technical advance in manufacturing processes drew the attention of Mr. Wilmot in the soldering and brazing department. Here, where the heating bodies take shape, torch brazing has been entirely supplanted by brazing furnaces. The new method has resulted in standards of consistency and quality hitherto unattainable, and has eliminated the risk of unseen faults in manufacture.

A glance at the empty test benches was a reminder that although the overall planning is complete, the factory is not yet in full production.

Certain stages are in operation—notably the manufacture of essential components of the automatic valve assembly—but about 60% of the equipment necessary for a full production run is yet to be installed. It is understood that adequate labour is " standing by " and that a smooth intake of operatives will be effected as the new equipment comes into action.

The resources of the factory are at present being devoted exclusively to the manufacture of an instantaneous multipoint gas water heater, known as type DLR 175. A technical description of this model will be given later. It is appropriate, however, to note at this stage that prototype models examined in the course of the visit entirely fulfilled the high expectations inspired by the impressiveness of the scene of creation. The extremely attractive exterior lines of the heater fittingly established it as the focal point of the visit. For the simple beauty of the white and apple green casing, credit is due to the designer, Mr. G. Grey Wornum, F.R.I.B.A.

More than Skin Deep

In the course of discussion with Mr. Wornum's assistant, Mr. R. A. Webber, it was learned that such beauty is, indeed, more than " skin deep." The design of an outer case could not be regarded as an independent problem. It was not merely a matter of producing a " streamlined " case that would appeal to the public eye. Rather should the external appearance come about as a development from the internal appearance. This, in fact, is what happened in the present instance, for at all stages in the technical design of the heater there was the closest collaboration with the architects responsible for " clothing " the unit. At the same time the practical advantages of good external design were considered and, as a result, the unit is not only pleasing to the eye, but is compact and space-saving, and easy to clean.

The Gas Industry—From Light to Heat*

By DEAN CHANDLER
South Metropolitan Gas Company

In this Paper the Author refers to matters of historical interest and discusses a development which he believes to be of importance to the Gas Industry

IF we were asked what effect the application of science to everyday affairs has on the lives of the average man and woman, it would probably be correct to answer that it enables them to experience new activities which were not possible before, and to carry out old established operations in a better way. The new activities may be more spectacular, such as flying and broadcasting, but carrying out established operations in a better way may be the more important, particularly if they meet essential needs.

It is not in the eruption of rare and revolutionary achievements that science finds its most characteristic—and on the average its most important—mode of service. It is rather in the continuous evolutionary application of familiar scientific principles, and in the better doing of something which is already being done after a fashion, that its principal mode of service lies.

In that paraphrase of the words of an eminent scientist we are given a glimpse of the real inspiration behind the application of science to everyday affairs.

The popularity of lighting by coal gas flames in the 19th century was attributable not only to the quality of the light, and to the fact that it was "light without a wick," but also to the simple construction of the burners employed. These early lighting burners, when they were properly made and correctly installed, were trouble-free over a long period of use. Maintenance was negligible for there was little in their construction to get out of order. It is of particular interest that the burners were of the non-aerated gas type, all the air required to burn the gas being supplied entirely at the point of combustion.

In 1855, a different type of burner was introduced by Bunsen. At that time the spirit lamp was used for laboratory work, but its flame required frequent attention and the reservoir had to be replenished with spirit from time to time. These inconveniences caused Bunsen to turn his attention to the use of coal gas as a constant and easily controlled means of obtaining heat. The gas lighting burner of his time was convenient to use and easily controlled, but its flame was unsuitable because of the tendency to deposit soot on the vessels heated. Bunsen set to work to overcome this defect and he discovered that by mixing air with coal gas in a specially constructed burner, a flame was produced which did not deposit soot. This burner, as well as bearing the name "Bunsen," became to be known as an "atmospheric" burner.

Historical Notes

It is, I believe, not generally known that the application of the principle of air entrainment to obtain a mixture of gas and air at the burning point had been carried out 30 years earlier by Faraday. Faraday's aerated gas burner was not exploited, nevertheless, it is a fact that he produced such a burner. A model is kept at the Royal Institution, London.

I asked the curator of the museum why Faraday did not make more use of his burner. The reply was that probably rubber tubing was not made in Faraday's day. We have to remember that the great value of Faraday's work was in theoretical discovery rather than in practical invention. He was more concerned with finding out what was true than with making what was useful.

The following description of the burner is taken from *Chemical Manipulation* by Faraday (p. 108, first edition) published in 1827:

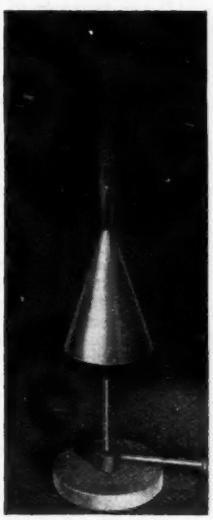

FIG. 1.—*Faraday's burner.*

Reproduction of the Woodcut.

"The gas burns with a flame resembling that of oil in its tendency to deposit fuliginous matter upon substances placed in it, this tendency being least with the gas from coal, greatest with that from oil. It may when required be prevented in several ways, by the admixture of air with the gas in certain proportions previous to its combustion; the flame being brought to resemble that of alcohol. This is best effected, not by adding air to a quantity of gas in a gasometer, which would always be partial and sometimes dangerous in its application to the burners. That necessary to produce a smokeless jet of flame from gas will be understood from the woodcut, in which is represented the section of a cylindrical single jet burner, and that of a conical cap made of thick sheet copper or brass, fastened by three or four cross wires to a ring, which slipping up and down upon the burner, admits of being supported at any required height. It should have an extent of motion up and down of about 1½ in., the aperture at the top should be one-fifth of an inch diameter. The other dimensions may be obtained from the figure, which is on the scale of 1 in 3. When the gas is turned on, it passes through a jet and issuing into the upper part of the cone, it there mixes with the air present, and passing out above by its levity, and the draught occasioned by the heat of the cone, is then burnt. More or less air may be allowed to mix with the gas by raising or lowering the cone. By depressing it sufficiently the air may be entirely cut off."

Thus Faraday almost anticipated Bunsen's device. Had he added a short straight length of tube to the top of the conical cap of his burner, he would have obtained reasonable flame stability and would have reduced the tendency to light back which must have been a serious and constant source of trouble. Earlier still Sir Humphrey Davy when making experiments in 1817, which led to the construction of the miner's safety lamp, placed on record that when gas and air were mixed together in a chimney and the mixture was ignited above a metal gauze placed on top of the chimney, the flame "burnt blue."

It has been said that "for the historian there is sometimes the difficult problem of assigning rightly a discovery to one of several claimants, of assessing the relative value of the seeing eye, the understanding mind and the practical hand." The origin of the "atmospheric" burner is a case in point.

It is fitting to acknowledge the great service Bunsen rendered to science, and the work-a-day world. Without the burner he introduced, the Gas Industry would have been seriously handicapped in the development and use of appliances for heating when gas rich in hydrocarbons was the order of the day. It is also difficult to imagine how the practical development of the incandescent system of gas lighting could have been successfully achieved without the Bunsen burner for which it was pre-eminently suited.

Having paid tribute to "A Master of Manipulation" as Bunsen has been appropriately called, it in no way detracts from the great service he rendered the Gas Industry to suggest that, had there been available in 1855 the quality of gas which is now being distributed, Bunsen might have produced a simpler form of burner for his purpose.

It is of passing interest that the commercially alert minds of two gas engineers, George Brooks Pettit and Harry Fly Smith, were not slow to grasp the possibilities of the atmospheric burner, and by letters patent No. 193, 1856, they secured protection for "Improvements in Gas Heating Apparatus," in which they described no fewer than 147 methods of applying the Bunsen principle of combustion to a variety of uses.

Early Bunsen burners were crudely made and were troublesome in use. They were very noisy and their tendency to backfire necessitated the use of fine metal gauze on the Davy lamp principle to overcome the trouble. The cure was, however, worse than the complaint, for the dust in the air was held in the fine mesh of the gauze, and in time clogged it and interfered with the proper aeration of the gas, which affected adversely the character of the flame.

Later improvements made in the design and construction of the Bunsen burner resulted in the discontinuance of the use of gauze, but trouble in another form caused by the deposit of dust in the burner persisted.

A dust-laden atmosphere is one of the unavoidable evils which exist in towns. As a consequence the air entrained by a jet of gas is seldom free from dust. What happens to some of these dust particles? First consider the effect produced by injector action. Owing to the velocity at which the gas issues from it, the immediate neighbourhood of the the injector orifice is a region of measurably reduced atmospheric pressure in relation to its surroundings. This difference in pressure, which is greatest at the point at which the gas issues, induces a flow of dust-laden air to the injector. Now, the pressure on a dust particle in the air stream is least on the surface which faces the injector and the particle is therefore forced on to it.

If the surface of the particle is "tacky," it adheres to the injector. This process is repeated until in time a considerable quantity of dust is deposited, as shown in Fig. 2.

If the dust is not removed at intervals sufficiently frequent to prevent considerable accumulation, the flow of gas from the injector and the consequent entrainment of air is in the course of time impeded, with the result that the burner fails to function properly.

*Paper to the North British Association of Gas Managers.

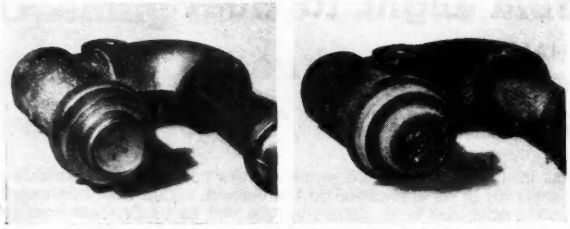

FIG. 2.—*Enlargement of Injector showing Accumulation of Dust.*

I have stated that the Bunsen burner, originally produced to supply the heat requirements of the laboratory, was afterwards extended to general heating purposes. In 1887, Welsbach heated a "mantle" impregnated with rare earths in the flame of a Bunsen burner and obtained a brilliant white light called "Incandescent Gas Light," but with its advent the simplicity of the earlier form of gas lighting was lost.

Steps Forward

The writer some years ago directed attention to the possibility of reverting to the earliest type of gas burner and of adapting it for use in modern gas appliances in order to recover the advantages of simplicity of construction and operation which had been lost. Upon reflection there seemed to be no logical reason why a modified form of the early gas burner could not be used successfully for heating purposes. Support for that view was found in a statement by Bannister, who, many years ago, observed that "numerous experiments in this country, performed by scientific men, and in France by Dumas and Regnault, had demonstrated that it was possible to consume a given quantity of gas in two differently constructed flat flame burners, each consuming the same quantity of gas, one developing the full illuminating power of the gas, the other only heat."

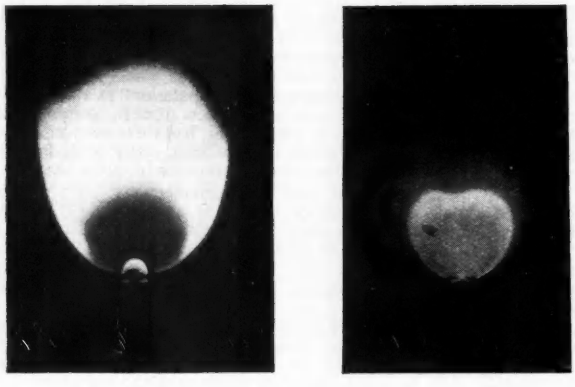

FIG. 3.—*Lighting and Heating Gas Flames—Bannister's Contrast.*

Note that the area of the heating flame is considerably smaller than that of the lighting flame, resulting in greater heat intensity per unit area.

The significance of the observation went unnoticed at the time, but that is understandable because the attention of burner makers was wholly directed to the development of burners to produce luminous flame.

A Turning Point

The practicability of using gas burners of this type for heating purposes has been greatly increased in recent years by the changes which have been made in the composition of town gas in order to satisfy present-day requirements.

When luminous gas flames were the popular illuminant, the gas engineer was chiefly concerned in making a gas which was rich in "heavy" hydrocarbon vapours, and which contained as little as possible of inert gases, for he realized that it was upon these vapours that he depended for light and that the presence of inert gases in any quantity reduced the illuminating power of the gas. In those days the gas engineer endeavoured to produce the greatest quantity of light at the lowest cost, which implied maximum candle-power possible per ton of coal carbonized as the goal, the attainment of which required close control of the carbonizing process to prevent "cracking" of the heavy hydrocarbon vapours and consequent deterioration of the illuminating power of the gas. To obtain these results necessitated methods of manufacture different in many respects from those which are practised at the present time. To-day, as a result of the work of Bunsen and Welsbach, intrinsic candle power has lost practical significance, and it is the number of therms produced per ton of coal carbonized which is the criterion by which the modern gas engineer measures the success of his operations.

To quote from the "Report on the Planning of the Gas Industry," by the British Gas Federation, now the British Gas Council:

"The Gas Industry as a Public Utility Service may be said to date from 1812, since when its technique and functions have been revolutionized. For a hundred years its primary service was lighting. Towards the end of the nineteenth century, however, the invention of the incandescent mantle reduced to one-eighth the amount of gas needed for the same amount of light, whilst electricity became increasingly used for lighting. Such development might well have shaken the structure of any enterprise, but the Gas Industry continued to expand by developing new functions as a heating industry in all its aspects, particularly cooking. These far outstripped the lighting load in importance and demand, and played a vital part in the conservation of coal."

"In 1919 the Fuel Research Board reported that 'the sheet anchor of the Gas Industry in the future must necessarily be its possession of the cheapest known means of distributing potential heat energy in a convenient form. For lighting and power production, the electricity suppliers of the future may seriously contest the field with the producers of gas, but for the supply of heat, gaseous fuel ought to remain if its production and use are developed on sound lines.'"

The following table shows the contrast in composition between typical gases made in 1900 and 1940, and does much to explain why the non-aerated gas lighting burner can now be used in modified form in domestic heating appliances.

TABLE I.—CHEMICAL AND PHYSICAL CHARACTERISTICS OF TOWN GAS.

	1900.	1940.
Composition (per cent.):		
Hydrogen	50.0	49.0
Ethylene	3.5	3.0
Benzene and toluene	1.0	trace
Methane	36.0	24.5
Carbon monoxide	5.5	12.5
Carbon dioxide	*Nil*	2.5
Nitrogen	3.5	8.0
Oxygen	0.5	0.5
Illuminating power (candles)	16	5
Calorific value (B.Th.U. per cu.ft.)	620	500
Specific gravity	0.360	0.450

The Road Ahead

The all-important problems for the Gas Industry in the present phase of its development are therefore:

(1) The processing of coal so as to produce a greater volume of gas for heating purposes per ton treated.

(2) The provision of simply constructed appliances by the use of which the potential heat in the gas could be effectively utilized without trouble.

That, I think, puts the matter in a nutshell.

It is not within my province to enlarge on the first of these requirements beyond quoting the late Dr. E. F. Armstrong, F.R.S., who, in an address to the Royal Society in 1944 on "The Gas Industry, Yesterday and To-morrow," said:

"There is a possibility, according to Dr. E. V. Evans, of producing from one ton of any coal—value 300 therms—some 210 therms of gas, together with a tar which can be hydrogenated to petroleum products and also compressed hydrogen. This possibility—the making of methane from coal—is being followed up with the full energy of the Gas Research Board."

The second of the requirements I have mentioned is within my province. It has been my business for upwards of 30 years to translate laboratory findings into practical achievement, and many useful and important lessons have been gleaned in the hard school of experience. For instance, I am satisfied that to fit appliances with gas burners having injector orifices and air ports of fixed dimensions, is fundamentally sound. For more than 30 years the South Metropolitan Gas Company carried out that policy which was laid down by the late Dr. Charles Carpenter. It required for its success in practice a standard gas and reasonably constant pressure. Even these precautions could not eliminate dust, the principal cause of trouble, although the best type of Bunsen burner was used.

The surest way of overcoming the trouble caused by the entrainment of dust was by breaking away from traditional methods of burner design, and, where possible, reverting to the type of non-aerated or neat gas burner, in which all the air required to burn the gas is supplied at the point of combustion. If the change over from Bunsen to non-aerated burners could be effected in a practical way, then it should, I think, be generally conceded that a considerable advance would be achieved, for at one stroke the dust trouble would be eliminated. We would then be in a position to place in the hands of our consumers an arrangement no more complicated than a gas tap and a correctly

proportioned jet, which could not easily be tampered with by the unskilled.

I am satisfied that this is sound practice and would be of great benefit to all concerned. This change, as we have noted, has been made possible in recent years and very many gas appliances fitted with non-aerated burners have been in daily use without giving any trouble.

It may be within the memory of some of the older folk in our Industry that William Sugg, who used luminous gas flames—and they were luminous—in his cooker ovens was awarded the Diploma of Merit by the National School of Cooking. Marie Jenny Sugg, his accomplished wife, in her treatises on Cooking, writes that Mrs. Clark of the National School of Cooking "after careful and extended trials at South Kensington, finally adopted luminous flames for the ovens at the school in Buckingham Palace Road, having proved to her satisfaction that they were better than Bunsen flames."

Why did Sugg adopt the Bunsen type of burner when he was convinced that it did not have any advantage over the luminous flame burner which he had proved to be better for heating gas cooker ovens?

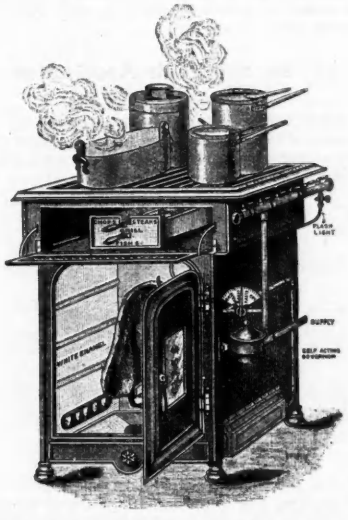

FIG. 4.—*Sugg Oven Heated by Luminous Flames. Prior to 1890*

It was, I think, because of the effect upon the public mind of the exaggerated and misleading statements made by partisans of the atmospheric burner, who extolled its merits without mentioning its faults.

One of the advantages claimed at that time for the atmospheric burner was that it gave more heat and, therefore, a better return for the money paid for the gas registered by the meter. That we know to be a fallacy because the total heat given by any volume of gas is easily and accurately determined by a calorimeter—an unfamiliar instrument then—and depends not so much upon the kind of flame produced, but on the completion of combustion of the gas and the design and construction of the apparatus in which the heat of combustion is liberated.

In other words, from the consumer's point of view, the effective utilization of the potential heat in gas depends upon the design and construction of the appliance in which it is burned.

Pertinent Observations

Familiarity can breed contempt and old institutions are abandoned sometimes not because they are obsolete, but merely because they are old. Trouble is not taken to examine and verify with sufficient care the claims made for what are alleged to be more up-to-date methods.

In a "Report to the Severn Valley Gas Corporation on the Use of Non-aerated Flames in Gas Appliances," published in the "GAS JOURNAL", April 21, 1943, Dr. J. S. G. Thomas expressed the opinion that "Conditions in the Gas Industry to-day point to the fact that the non-aerated burner has been rather too hastily abandoned by the Industry, which has much to gain by a return to its 'first love.'"

"The Industry," says Thomas, "generally labours under two misconceptions regarding the characteristics of non-aerated flames: (1) It is usually imagined that combustion in non-aerated gas flames is less complete than in the Bunsen flame, and (2) it is generally considered that the Bunsen flame is very much hotter than the non-aerated flame—the so-called luminous flame. Both are erroneous. After all, is not the calorific value of gas determined in accordance with statute law in a calorimeter using a non-aerated flame? And is it likely that this type of flame would be used for such purpose if combustion in it were less complete than in a flame of the non-aerated type? Extensive experimental work has shown that combustion can be equally complete in flames of either the Bunsen or non-aerated type, and moreover, when combustion is complete in either, the amount of heat developed per cu.ft. of gas burned is the same. Again, while in general the Bunsen flame has a slightly higher overall temperature than the non-aerated flame, this difference is small. There are parts of the non-aerated flame which are at least equal in temperature to the highest found in the Bunsen flame. Further, either flame possesses an average temperature which is more than adequate for the tasks that gas is called upon to perform.

"The Bunsen burner is a highly scientific instrument: too often it is treated with the familiarity that breeds contempt. It is my opinion that it never will become a foolproof appliance. That characteristic belongs only to the non-aerated type of burner. This is making a little headway in the Industry. It would have made much more had it not been for the war. In the days immediately preceding 1939 I saw a number of gas fires employing flames of the non-aerated type. They burned perfectly silently and performed equally well when supplied with 450, 500, or 560 gas. They were, in my opinion, a very considerable advance on anything we have yet had in the way of a gas fire. They could be turned down to one-quarter of their normal consumption without any sign of sooting, except in the case of the fire supplied with 560 gas. I have no doubt whatever that this type of gas fire will be *the* fire in post-war years.

"I have in my kitchen at Cheltenham a New World Alpine gas cooker having luminous burners in the oven. After three years' satisfactory service in the area of supply of the South Metropolitan Gas Company (C.V. 560 B.Th.U.) it was moved to Cheltenham (C.V. 450 B.Th.U.), where the oven burner required no adjustment, although the hotplate burners required very considerable adjustment owing to the transfer. Pressure of gas supply to the oven can be turned down to the very limit without producing sooting, firing-back, or any trouble whatsoever. Not so the hotplate; a moderate drop of pressure of supply causes firing back, with all its consequent troubles. I have experimented in the laboratories of the South Metropolitan Gas Company with a hotplate provided exclusively with burners of the non-aerated type. A successful model was developed, and I have no doubt will be marketed in post-war years. One advantage of the oven provided with non-aerated burners is the fact, borne out by five years' experience, that cakes cooked in such an oven are better browned than when cooked in ovens of more orthodox type. The oven with non-aerated flames has my very strongest commendations; I have no doubt at all that the non-aerated cooker top is on its way."

I have quoted Dr. Thomas at some length because his report was made after critical examination and without bias.

In a recent paper on "'Neat' Gas in Service" C. G. S. Rolls (Radiation Ltd.), in a paragraph on "Comparison of Bunsen and Non-aerated Flames" said, "In designing any gas appliance to attain the prescribed combustion standard with a high thermal efficiency there is no insurmountable obstacle against the use of non-aerated flames. The ability of the Bunsen burner or the Bray jet burner to meet all requirements can be judged by comparing their general characteristics, and by regarding them in connexion with the major domestic appliances.

Firstly, no Bunsen burner has been made that is silent in use. Noise is due to the following causes:

(*a*) The hiss of gas discharged from the injector orifice, set up by friction.

(*b*) The resonance created at the open end of the burner (an organ-pipe effect).

(*c*) Noise caused by friction within the burner, from surface roughnesses and changes of direction.

(*d*) Flame rattle which accompanies vibration of the inner cone due to turbulence set up in the air/gas mixture by burner friction, obstruction at the flame ports, and excessive aeration, which may be due to a change in the gas characteristics since the burner was initially adjusted.

All of these can be minimized, but it is not possible to eliminate noise entirely.

At usual district pressures, non-aerated flames can be produced that are completely silent, and this is an advantage with all gas appliances, particularly gas fires."

Noise, Flame Stability, and Turbulence

The problem of flame stability seems to be one which troubles some engineers who have been led to believe that the use of non-aerated gas burners necessitates the employment of a pressure governor in all circumstances. That is not true, for in some circumstances a pressure governor is not required. Thousands of burners of this description have been in use without pressure governors for a long period and I can say with conviction that under the conditions in which they have worked and are still working, a governor is not necessary. Nothing more is required than the small throttle which can be set to reduce the pressure where it is too high. As an example, ring burners fitted with 000 and 000 + neat gas jets made by Bray were

tested at our Old Kent Road laboratories at pressures ranging from 25/10ths W.G. to 80/10ths W.G. with the following results:

TABLE II.—C.V. OF GAS, 530 B.TH.U./CU.FT. SPECIFIC GRAVITY 0.41.

	000 Jets.			000+ Jets.		
Pressure	25/10 in. w.g.	50/10 in. w.g.	80/10 in. w.g.	25/10 in. w.g.	50/10 in. w.g.	80/10 in. w.g.
Hourly gas rate, cu.ft.	12.9	18.8	24.3	18.3	26	32.5
Time to boil 3 pints	9m. 0s.	7m. 0s.	6m. 0s.	6m. 50s.	5m. 35s.	5m. 10s.
Efficiency	55.5%	49%	41.8%	49.5%	44.6%	38.5%
*CO/CO_2	*Nil*	*Nil*	*Nil*	*Nil*	0.002	0.014
	Silent	Slight noise	...	Silent	...	...
		Noise at pressures above 50/10 in. w.g.		Noise at pressures above 33/10 in. w.g.		
		At 80/10 in. w.g. the flames did not lift from the jets.				At 80/10 in. w.g. the flames did not lift from the jets.

* The limit ratio under abnormal conditions given in B.S.717 "'Combustion Testing' of Domestic Gas Appliances" is 0.02. It will be observed in the results of the tests of the ring burners that the CO/CO_2 ratio is considerably below the limit given.

A pressure governor is desirable for gas cooker ovens and for gas fires, but for boiling rings, portable heaters, wash coppers and some other small appliances, a simple throttle device is effective and is all that is required.

Noise, flame stability, and turbulence are closely related to the design and construction of the burner itself. This has not been properly appreciated in the past and I fear it has given rise to the idea that neat gas flames can function properly only at comparatively low gas pressures.

Observations made by my colleagues on the characteristics of neat gas flames, reported in Communication No. 260* to the Institution of Gas Engineers, directed attention to the phenomenon that at a certain specified gas pressure the flame given by a gas jet made by Bray became noisy and that at some other pressure (which might or might not be higher) the flame tended to lift off the burner head if there was a slight draught. They suggested that noise was due to turbulence of the gas stream within the flame area and that instability was due to the velocity of the gas stream reaching some critical value relative to flame speed.

More recent experimental work has confirmed these conclusions, but it has also shown that turbulence of the gas stream in the flame can be the result of turbulence in the manifold itself and therefore prior to the gas issuing from the jet. It is now realized that turbulent conditions produced in the manifold are of very considerable importance, and that when burner manifolds are properly proportioned and correctly designed, much of the unsatisfactory experience of the past is obviated.

An instructive example of how turbulence in a bar burner manifold was overcome at low pressures follows:

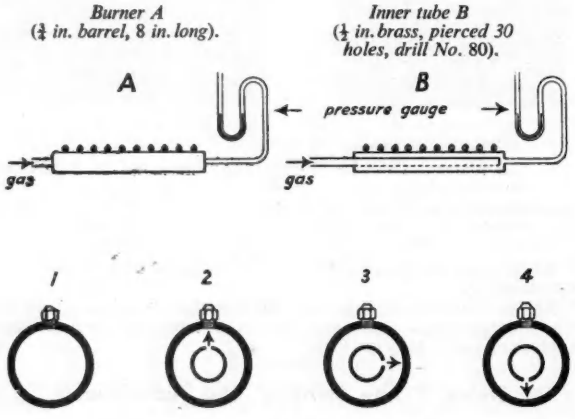

FIG. 7.

The manifold of burner A was fitted with 10 No. 0 Bray gas jets. It was found that at 19/10ths W.G. pressure the flames were ragged and noisy. Burner A was then fitted with an inner tube, B, pierced with a number of small holes. This tube was fitted in the chamber of the burner and its effect was to supply gas at a steady rate of flow to all the jets in the outer tube, and it was found that on ignition the flames burned quietly up to 58/10ths pressure. An increase in working pressure from 19/10ths to 58/10ths was obtained by the use of the device.

But before the most effective position of the inner tube in relation to the outer tube was found, various positions of the inner tube were tried and it was found that the best result was obtained when the holes in the inner tube were in position (4).

(1) *Burner without inner tube.* Flames silent and stable at pressures up to 19/10ths. Flames unstable in draughts at 58/10ths.

(2) *Burner with inner tube, gas emerging in direction of arrow.* Flames silent and stable at pressures up to 19/10ths. Flames unstable in draughts at 58/10ths.

(3) Flames silent and stable at pressures up to 44/10ths. Flames unstable in draughts at 58/10ths.

(4) Flames silent and stable at pressures up to 58/10ths.

Hourly gas rate at 19/10ths—37 cu.ft.
" " 44/10ths—57 "
" " 58/10ths—65 "

It is obvious from these experiments that the design of the burner chamber or manifold is a very important factor in extending the limits of pressure at which neat gas jets can be used before troublesome turbulence is produced.

A Note on Jets and Their Application to Neat Gas Burners

A standard metal casing is used to hold the refractory jet, the orifice of which is made in different sizes from which one size can be selected to meet the requirements of any gas supplied within the range 400 to 550 B.Th.U. per cu.ft.

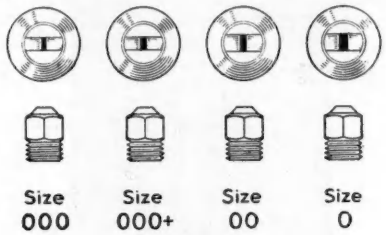

FIG. 6.

With the desire for standardization in most fields of household fittings and appliances, this is an advantage for it means that with a standardized jet casing the only variation will be the size of the orifice of the jet to suit the special characteristics of the gas with which it is to be used.

(*To be continued*)

* *Further Observations on the Combustion Characteristics of Town Gas*, Fuidge, Dewhurst and Pleasance.

Home Planning at St. Helens

A new exhibition of gas appliances was held at Radiant House, Ormskirk Street, St. Helens, recently and was attended by many visitors. Ald. W. **Burrows,** Chairman of the Gas and Lighting Committee, said the exhibition served a double purpose. First, it was to bring to the notice of the public different types of domestic appliance which they of the Gas Department believed were not only useful but essential for post-war houses. The second use of the show was to present an opportunity of hearing experts give information and answer questions on any points where elucidation was necessary or criticism was felt to be justified, with the general idea of improving service to both builder and consumer.

They would already know that it was the desire of H.M. Government that gas should be laid on to every new house, and therefore the Gas Committee, in their forward programme, were seeing to it that an adequate supply of good gas was always available. The gas undertaking was a public servant and was always ready to serve.

Mr. **R. L. Greaves,** Borough Gas Engineer, in a short address welcoming the visitors, revealed that statistics showed that gas laid on in new houses was in nearly every case utilized by incoming tenants. It was much the best to install service when the house was being built, to avoid structural damage later. He also told his hearers that St. Helens undertaking was, by present standards, well stocked with appliances for sale to the public.

After a brief tour of the exhibition which showed every variety of gas appliance from refrigerators to airing cupboards, a series of three talks with illustrations on the epidiascope were given by Mr. R. Owen, of Beard & Co., Liverpool (" Nautilus Economy Gas Flues "), Mr. P. L. Blunt, Eagle Range (" Heating by Convection," " Coke Burning Appliances "), and Mr. Hugh Barnes, Sawer & Purves (" Meteor Circulator ").

The exhibition itself included complete kitchen sets featuring streamlined modern cupboards stocked with cardboard cut-outs of groceries, kitchen units, and everything that is latest and best in gas appliances.

Association of Public Lighting Engineers

THE 1946 Conference of the Association of Public Lighting Engineers was held in London from Sept. 10 to 12, delegates coming from all parts of the country. In connexion with the Conference, was a very complete exhibition of public lighting apparatus and equipment in the Central Hall, Westminster, where all the Conference meetings were also held. There were some 1,000 delegates, representing 533 local authorities.

The proceedings opened on Sept. 10, under the Presidency of Mr. E. J. Stewart (Glasgow), who extended a cordial welcome to the Rt. Hon. Alfred Barnes, M.P. (Minister of Transport)

The MINISTER OF TRANSPORT then addressed the Conference and recalled the circular issued by the Ministry of Transport on Aug. 26 last, in which it was announced that the Ministry has now become the Central Authority responsible for street lighting. As he had only recently assumed responsibility for street lighting it was too early for him to say on what lines policy would be developed during the coming years. He was, however, impressed with the view that there should be the greatest possible degree of uniformity in the standards of street lighting and that wherever street lighting was provided, it should be to approved standards. To achieve this most desirable object it might be necessary in some cases to consider placing the responsibility for street lighting in the hands of larger administrative units, and to all these factors he was now giving his attention. That was a tendency which did not apply to street lighting only in these days, and the more people who expressed views on these problems the more definite and intelligent would be the final decision. The aim and purpose of all concerned with public lighting was to obtain the best possible lighting from any existing source, and when he had spoken of uniformity, he did not mean any one particular type of illuminant, for good lighting could be provided in a variety of ways, the two important factors being the right amount of light and its proper use.

He referred to the manner in which the Association had co-operated with Government Departments in the past, mentioning particularly the Departmental Committee of 1936, and commenting on the fact that the Association had sought the co-operation of lighting engineers in other countries he specially welcomed to this Conference representatives from the United States, Australia, France, Holland, Denmark, and Sweden, adding that had transport facilities been easier, other representatives from abroad would also have been present.

Expressing the hope that there would be still closer co-operation in the future than there had been in the past between the Association and the engineers of the Ministry of Transport, he said that while the standards of lighting should be such as to ensure the safe use of our highways at night, every endeavour should be made to prevent the installation of lighting apparatus which detracted from the amenities of the roads. In this connexion he was glad to know that the Association was not only encouraging manufacturers in the production of street lamp columns of sound and pleasing design, but that it was also working in close liaison with the Royal Fine Arts Commission and the manufacturers of street columns, and that the Commission had agreed to examine designs submitted to them and commend those which they considered suitable. He expressed the hope that lighting authorities might consider requiring, as a condition of any contract which they might let, that the lamp columns to be adopted were of a type recommended by the Royal Fine Arts Commission.

It was emphasised that greater safety on the roads must be the primary aim of all street lighting, and remarking that one quarter of the fatal accidents and a fifth of all road accidents took place in the hours of darkness, Mr. Barnes suggested that some of these would be avoided if streets were lighted to a better standard. He recommended that what money and services could be applied to street lighting now should be used for the provision of good lighting of a small mileage of road rather than a larger mileage of mediocre or very poor lighting. Thus, whatever scheme of street lighting could be carried out now or in the near future, should be designed to fit in, as far as practicable, with the scheme of lighting which was necessary for the particular road in question, with due regard to the recommendations of the Reports of the Departmental Committee on Street Lighting.

Continuing, he said that as the standard of street lighting was raised, it would be necessary to raise the standard of qualifications of the lighting engineer, and public lighting should, wherever possible, be in the hands of fully qualified lighting engineers. He was glad to know that it was the common practice among the larger lighting authorities to create a separate public lighting department and to place it in the hands of a fully qualified engineer. Indeed, he had been told that in every case where this had been done, the standard of lighting had improved both in value and economy.

In his concluding remarks, the Minister commented on the many examples now existing of good lighting on certain roads and poor lighting on continuing lengths of the same road under the jurisdiction of another lighting authority, and urged greater consultation between adjacent lighting authorities to ensure uniformity of lighting on important through routes.

Finally, he asked all lighting authorities to look to his Department for guidance on street lighting matters, and at the same time expressed the hope that there would be the fullest measure of co-operation between the members of the Association and the technical officers of the Ministry of Transport.

The Minister of Transport was cordially thanked for his Address, and he then made a tour of the Exhibition, which he formally opened. A description of the Exhibition appears below.

The Exhibition

In the exhibition, all the lighting fuel industries were represented, and the British Gas Council provided an information centre for all matters concerning the use of gas for public lighting. Below we give brief notes of some of the exhibits.

ASSOCIATION OF METAL SPRAYERS.—Metal spraying as carried out by the members of the Association is claimed to be the best method known to modern industry of preventing corrosion. Independent scientific bodies working on the prevention of corrosion have indicated that when conditions are severe a metallic coating applied to a clean steel base is the best method of preparation for final painting. From the point of view of public lighting the maintenance of lamp standards and standard arms is a considerable expense. The extra initial cost of cleaning the parts by means of grit blasting and the application of a metallic coating by spraying is soon saved in the maintenance costs due to the fact that articles so treated do not rust. This has been proved in actual conditions, and thousands of lamp standard arms have been treated with success. Where parts get hot, corrosion is accelerated. To a maximum temperature of 500° C. the aluminium coating, as sprayed, is effective as a protective finish. If parts reach temperatures of from 500° C. to 900° C. the aluminizing process is still the complete answer, and in this process the parts are sprayed with aluminium in the usual way and are afterwards heat treated. Lighting engineers are familiar with the sprayed gas burners which were common before the war and will be familiar with the fact that the use of multiple jets was only possible by taking advantage of the protection offered. In the same way this protection can be adopted to cooker plates and stove parts.

BRITISH, FOREIGN, AND COLONIAL AUTOMATIC LIGHT CONTROLLING CO., LTD.—A comprehensive range of street lighting controls for both gas and electricity was included on this stand. "Gunfire" controllers are well known, and models for all purposes, from the standard square lantern type to the more elaborate suspension types, were exhibited. In addition, there were industrial types for heating control, &c.

BRITISH GAS COUNCIL.—Enlarged photographs of modern gas lighting installations, together with diagrams relating to the use of gas, were on view at the British Gas Council's stand, and an illustrated brochure was available to visitors. Lighting engineers and others interested in street lighting problems found in the information bureau the latest information on the use of gas for the lighting of all classes of roads in conformity with the recommendations of the Ministry of Transport Departmental Committee on Street Lighting.

CONCRETE UTILITIES, LTD.—The main exhibit illustrated the Company's patented method of fixing concrete brackets. Also on show were scale models of their latest design of columns, with several sections of concrete showing various finishes available. Scale models (1 in. = 1 ft.) showed two designs originally approved by the Royal Fine Arts Commission. One of these brackets was mounted on a narrow base pole occupying only 9½ in. across the pavement, and intended for use where space is restricted. A photograph showed a narrow base column installed at Hitchin, Herts. No restriction is made in the base compartment, which houses all usual operating gear. The finishes shown were some of the many available.

WILLIAM EDGAR & SON, LTD.—Owing to lack of space, this firm was showing one lantern only, namely the Eclipse. This lamp has been extremely successful over many years of life, being highly windproof but yet of graceful design. Other types of lamps manufactured by the firm are the Rivercourt lamp and the Caxton range of square and circular lamps. All lamps can, of course, be fitted with distance or clock contols if required.

FOSTER & PULLEN, LTD.—Space being limited this Company showed a range of models, made to scale, of their lighting equipment. Any group "B" scheme can be carried out by one or other of the lanterns shown. Shortages of labour and essential raw materials are being slowly overcome.

GOWSHALL, LTD.—Exhibits included a selection from a comprehensive range of illuminated guardposts. These differ in design but conform to high standards of quality and finish, embody the best materials, and have regard for ease of installation and maintenance. The exhibit showed stove enamelled finish on steel that is firstly rustproofed,

glazing frames of cast silicon aluminium, brass locks, "Keep left" and opal panels of three ply safety glass. Other guardposts have vitreous enamelled finish, but include similar materials. All components are standardized and can quickly be replaced on site even by unskilled labour. In addition to guardposts internally illuminated signs and external lighting fittings were displayed. The "Mandalite" fitting is for lighting mandatory, prohibitive, warning, or informative signs, light being distributed to the top ring, disc, or triangle, and also to the sign below. With all signs, lighting fittings, and guardposts, provision is made for two lamps; lampholders, switchgear panel and terminal block are standard fitments, and where gas is the light source adequate ventilation and design permits equal results.

HORSTMANN GEAR COMPANY, LTD.—The Mark IX Comet and the 3A/UNI Controller were shown on this stand. This combination represents an up-to-date and efficient method of gas public lighting control. Comet ignition is well known for dependability and efficiency and has stood the test of many years. The experience gained combined with intensive research has resulted in the production of the Mark IX, the most up-to-date of these series, which embodies all the latest improvements. Special attention has been paid to the electrical portion which has now been rendered free of tracking. The shortened battery case facilitates the changing of batteries in square lanterns and although a smaller battery is now fitted the efficiency and length of life is not impaired. Numerous authorities have adopted Comet ignition, which eliminates by-passes and gives greater efficiency and economy. It has been estimated that an average annual saving of up to 1,500 cu.ft. of gas per lamp is effected, an outstanding achievement when economy is so vital to street lighting. A range of controllers for use with vertical or descending supply lanterns, embodying hand-set or solar dials, was exhibited. Shortage of materials has held up production and caused delay in delivery of orders, but it is hoped that this situation will soon ease.

LIGHTING TRADES & WELSBACH, LTD.—All types of gas mantle, from the minute example required for the illumination of a microscope stage to the robust and extended efforts demanded for lighthouse work and high pressure street lighting, were on show, as well as the specialized types used in tropical countries and other places where gas is not available but oil—suction or pressure fed to the burners—must be employed. The scarcity of supply of raw materials during the war and post-war periods has made more difficult than usual the extraordinarily complex and delicate processes of manufacture (illustrated by the various samples on exhibition), and shortage of labour and supplies, has in common with the experience of many other manufacturers, had the effect of retarding expansion of output. The demand for mantles of the Welsbach type is far greater than pre-war, the necessity for rehabilitating and ultimately restoring street lighting to pre-war standards making enormous demands on production at a time of special difficulty in securing adequate output. Quality, as shown by production specifications and final tests, is being maintained and quantity is merely a matter of time, materials, labour and opportunity. Lighting Trades & Welsbach, Ltd., were also exhibiting some of their standard street lighting lanterns and equipment, specially made to give the best results with any gas and any mantle, and especially so with their own products. A striking exhibit showed the development during the year in the application of totally reflecting and refracting glass prisms, which aroused so much interest when displayed for the first time at the 1945 Conference at Glasgow. Preliminary quantities of these ingenious devices will be installed during the coming lighting season in certain selected lighting areas, to get experience in actual use of the benefits and advantages which have been demonstrated on a small scale.

W. PARKINSON & CO.—Post-war gas street lighting units exhibited comprised the Maxilla range of upright and suspension lanterns, designed especially for residential areas, and roads for Group "B" lighting to Ministry of Transport requirements, with mounting height 13-15 ft. Standard interchangeable parts have been adopted where possible, which has reduced the cost of manufacture and the number of components required as spares. The suspension lanterns are all fitted with a concealed safety chain device. Fixed nipples and constant pressure governors are included as standard fittings to ensure that the laboratory results are reproduced wherever the units are installed. The street lighting effectiveness has also been enhanced by the adjustability of the faceted reflectors, which are constructed of aluminium anodized by an improved process, permitting effective distribution of light for variations in the configuration of the road, including bends, gradients and varying road widths. Rectangular sides replace the tapered in order to facilitate easy replacement of five glass panes (sides and base), each being of identical size. Heat-resisting glass panes are introduced into the lantern with the larger size burner assembly, and are placed opposite the 40-faceted reflector. The whole of the burner assembly, from nipple to pre-heater, is the same for all lanterns and for all sizes of pre-heaters from 2 to 6 light. The standard venturi tubes and fixed nipple are controlled to the size required for the particular size of pre-heater. The venturi maintains the 7-1 ratio, whatever quantity of gas is passed.

POLES, LTD.—The pursuit of the ideals of simplicity, efficiency, refinement, avoidance of pretentiousness and vulgarity has culminated in the achievement of the "Adastra" hexagonal standard, which fulfils both artistic and practical requirements. Examples of these columns were shown on the stand of Poles, Ltd., who have arranged for their production on a large scale. In design it is a graceful tapering pole of hexagonal section with finial and arms perfectly proportioned. The standards are assembled on site from nested sections of approximately 8 ft. in length, which are easily transportable in large quantities. The actual erection can be carried out by two men without any special gear, and ample accommodation for switches, chokes, &c., is provided in the base section of the pole itself. The life of the standard is ensured by the heavy coating of spelter which is applied finally, after completion of fabrication. Examples of this finish can be seen on poles of round or elliptical design supplied before the war, and which have not cost anything in maintenance since they were installed.

STANTON IRONWORKS CO., LTD.—The central feature of the stand was a specimen centrifugally spun concrete lamp column with a mounting height of 15 ft. 6 in., surrounded by a small stand in which there was a porthole to allow the root portion to be seen. The Company also showed three scale models, 2 in. to the foot, of other types of spun concrete columns with standard finish of permanent smooth artificial stone surface, grey in colour. The important feature of the Stanton column is the smooth granolithic finish obtained by grinding after the centrifugal moulding has taken place. This results in a permanent finish that does not require painting or other maintenance.

STEWARTS & LLOYDS, LTD.—On this stand was exhibited a range of gas tubing, ⅛ in.-6 in. bore, screwed and socketed together with various types of screwed fittings, also a collection of sample tubes demonstrating the various methods of protective linings and coverings. There was a lighting column, 15 ft. mounting height, complete with swan-neck bracket, and fitted with switchgear, condensers, &c., also lantern and globe and suitable C.I. collar and C.I. footpiece for ornamentation purposes. There was also exhibited a pillar type of lighting column, complete with lantern and lighting unit, and a suitable C.I. dwarf base for ornamentation purposes. In addition a base section of 25 ft. mounting height lighting column was exhibited, fitted with switchgear, condensers, and generally used for lighting traffic routes. Arranged around the stand was a collection of photographs showing various types of lighting columns in use. Numerous samples of victaulic joints and fittings were also seen, together with plain-ended tubes fitted with the Johnson couplings. Other means of coupling steel tubes together were demonstrated by samples of inserted joint, sleeve-welded joint and spherical welded joints. To complete the exhibit there were numerous samples of fittings, such as tees, bends, crosses, syphon boxes, &c., used in conjunction with inserted and sleeve-welded joints when installing service mains.

WILLIAM SUGG & CO., LTD.—A selection of gas lighting units taken from a wide range of appliances manufactured with the advantage of over 100 years experience in the performance of good gas lamps, was provided for convenient inspection. The B/3 Model "London" lamp, embodying improved modifications to the top casing, is extensively used for modern street lighting, and is primarily designed for Group "A" schemes. It has a special mirror glass optical system, which can be easily and accurately adjusted to obtain the best result according to the nature of the surface of the road. Alternatively, special reflector systems can be supplied, these being a low cut-off system, and a back reflector to give unilateral distribution. The "Rochester" lamp, which can be supplied in suspension, upright or bracket form, can be employed for most street lighting requirements. The "8000" lamp is designed to conform to the Ministry of Transport's recommendations for Group "B" lighting, and is also suitable for the lighting of new housing estates. The lamp was shown with two distinct forms of mounting. It constitutes an ideal conversion unit for bringing existing gas installations up to date, employing existing columns, at the least possible cost. The new Sugg-C.U.-concrete bracket and column, in which the clock controller, Comet igniter, &c., is concealed in the actual bracket arm, provides a modern lighting unit suitable for new housing schemes. There was also displayed a working model of the Sugg centralized control system for gas street lighting, which illustrated how master control for any number of lighting units can be arranged. Simplicity is the keynote of the system; a relay pipe is provided to operate the relay valves on lamps, which are equipped with either by-pass or Comet ignition.

WILLEY & CO., LTD.—This Exeter firm, which has been manufacturing and supplying to the Gas Industry a wide range of equipment for more than a century, showed its "Cranford" lamp, which is of entirely new design, embodying numerous special features. The small size and clear cut design of the lantern, mounted on the swan neck, gives the Ministry of Transport recommended height to light source of 13 ft. on existing standard 9 ft. 6 in. columns. Maintenance facilities are simple, the control clock and weep governor being removed completely by the removal of two set screws. Other special features are the high lighting efficiency and the impossibility of firing back through the swan neck—by means of a special governor which maintains a pressure of five-tenths in. when the lamp is extinguished—allowing the mechanism to be mounted at the base of the swan neck within easy reach for winding, &c.

Separation and Chemical Utilization of Coal Gas Constituents*

By N. BOOTH, B.Sc., Ph.D., F.R.I.C.
Principal Scientific Officer, Gas Research Board

(*Concluded from p. 440*)

Ethylene

Ethylene is the first member of the olefine series of hydrocarbons, which are chemically unsaturated and, therefore, extremely reactive. In the manufacture of synthetic materials such as plastics or rubber it is desirable to start with relatively simple molecular units, usually those with no more than 4 carbon atoms. The units chosen must be reasonably reactive, and ethylene occupies a special place in chemical synthesis on account of its simplicity and reactivity.

There are three sources from which ethylene can be produced for use in syntheses in this country. They are ethyl alcohol, coal gas, and refinery gases. In countries such as America, in which there is abundance of natural gas, it is possible to convert some of it to ethylene, although with only moderate yields. Another possibility is to hydrogenate acetylene:

$$C_2H_2 + H_2 \longrightarrow C_2H_4,$$

but acetylene made from calcium carbide is likely to be expensive for this purpose on account of high cost of power required to manufacture carbide from lime and coke.

Prior to the war, manufacture of industrial alcohol in this country was an industry with a steadily increasing output. It was made by fermentation of imported molasses, using specially propagated yeast. The yeast contains an enzyme called invertase, which converts the sucrose in the molasses into dextrose and lævulose by the reaction

$$C_{12}H_{22}O_{11} + H_2O \longrightarrow C_6H_{12}O_6 + C_6H_{12}O_6$$

Another enzyme present in the yeast is zymase, which converts dextrose and lævulose into alcohol by the reaction

$$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$$

These reactions take place in the liquid state in tanks maintained at 26° to 36° C., and a liquid containing 7 to 8% of alcohol is obtained. It is then distilled in order to concentrate the alcohol.

Alcohol can be converted to ethylene by heating with either concentrated sulphuric acid or syrupy phosphoric acid, since both these substances have a high affinity for water:

$$C_2H_5OH \longrightarrow C_2H_4 + H_2O$$

In 1938, production of industrial alcohol in this country was about 175,000 tons, equivalent to about 106,000 tons of ethylene. A great amount of this alcohol was, however, employed in preparation of lacquers and varnishes, and some was used for direct manufacture of chemical products.

Alternative sources of ethylene are gases produced during cracking and reforming processes in the petroleum industry. More than half of this gas is methane, and could be treated in the same way as natural gas, *i.e.*, by cracking to give ethylene. Apart from this, however, refinery gases contain about 7% of ethylene by volume; the quantity of ethylene in refinery gases throughout the world was more than 2 mill. tons in 1942.

By fractionation of refinery gases under pressure a light fraction containing only methane, ethane and ethylene can be obtained. The ethylene can then readily be removed by chemical means, since it is much more reactive than either methane or ethane. This has been effected for the last 12 or 15 years by absorption in sulphuric acid, while in recent years other methods, such as direct hydration, have been examined. It has been found that if moderately dilute sulphuric acid be employed at temperatures and pressures above atmospheric, alcohol can be produced continuously, thereby avoiding the necessity of reconcentrating the sulphuric acid. Another method which has been used is to treat the gaseous mixture with chlorine water, whereby ethylene chlorhydrin is produced:

$$C_2H_4 + HOCl \longrightarrow HOC_2H_4Cl$$

It seems possible that these methods might be used in treating an ethylene fraction separated from coal gas by liquefaction.

Up to the present time, Great Britain has imported petroleum products which are for the most part already refined, with the consequence that large quantities of refinery gases have not been available. Since the maximum temperature at which ethylene will remain a liquid whatever the pressure applied, is 9.7° C., it cannot be transported conveniently in this form. Consequently, supplies from petroleum will only become available in Great Britain if home refining is undertaken on a large scale.

The remaining source of ethylene is coal gas, and methods by which it might be separated have been referred to above. It is clear that alternative sources involve importation either of molasses or of petroleum, and installation of a considerable amount of plant. In erecting plant to separate ethylene, therefore, the carbonization industries should be at no disadvantage.

The price of industrial alcohol immediately before the war was about 2½d. per lb. Consequently, ethylene made from this source would have cost rather over 4d. per lb. The decision of the Chancellor of the Exchequer, last year, to remove the subsidy, on this alcohol, of 5d. per "proof" gallon would increase the ethylene cost to about 6d. per lb. This may be compared with a price of less than 2d. per lb. (based on 1938 costs), which is suggested as the price at which ethylene might be available from coal gas after separation by liquefaction, as part of an integrated scheme.

Uses of Ethylene

Ethylene is an important material for synthesis, both on account of its simplicity and its reactivity. No other starting material enables as many substances to be built up from it. It is interesting to note that processes for making 50 chemicals from ethylene have been taken to the stage at which commercial manufacture could be undertaken, provided that the market demand were adequate. This does not complete the possible uses, however, since there are many other substances on the market which can readily be made from ethylene in the laboratory, and for which commercial processes might be developed.

The products likely to be made in greatest quantity from ethylene are plastics and rubbers. Classification of the various materials that can be produced is a matter of some difficulty. It has been suggested that all synthetic rubbers and rubber-like materials should be called "elastomers," while true thermoplastic and thermosetting substances should be called "plastomers." It should be noted that synthetic rubber in the literal sense of the expression has never been prepared, since a material identical in chemical composition with natural rubber has not been made. So-called synthetic rubbers are, therefore, substances which have certain desirable properties in common with natural rubber, and in all cases they are polymers of a single substance or co-polymers of two substances. Manufacture of synthetic rubbers, therefore, consists in preparing the raw material and then building up larger molecules from the relatively simple molecules of the starting materials. It is often possible to prepare a substitute material which is superior to natural rubber for the main purpose in view, although it may be inferior in some of its less important properties.

More than 30 synthetic rubbers have been produced, but the one which has found most general application is "Buna S," which during the war has been produced in Germany and the United States of America in very large quantities. American production, for example, reached 845,000 tons per annum. "Buna S" has properties very similar to those of natural rubber, but is superior in respect of resistance to aging, to water absorption, and to tendency to swell in mineral oils. It is, therefore, particularly useful for purposes which require these properties, such as coverings for cables. It is also very resistant to heat and abrasion, and it has been claimed that, in Germany, automobile tyres made with "Buna S" lasted 35% longer than if made with natural rubber. The method of processing "Buna S" is to plasticize it by hot-air treatment under carefully controlled conditions. It can be vulcanized in the same way as natural rubber.

Considerable quantities of other rubbers have been produced, but in many cases exact amounts are not known.

"Buna S" rubber is manufactured from butadiene and styrene. These two liquids are mixed and emulsified, using an emulsifying agent. They are then passed through a number of reactors maintained at about 45° C. A different catalyst is used in each reactor and total reaction time is about 30 hr. The latex is then subjected to steam distillation to remove unreacted material.

Styrene can be manufactured entirely from products of coal carbonization. This is done by taking ethylene and benzene in the ratio of 2: 1 and mixing them at atmospheric pressure and 90° to 100° C. in the presence of aluminium chloride. In this way ethyl-benzene

* From Communication No. 294 of the Institution of Gas Engineers.

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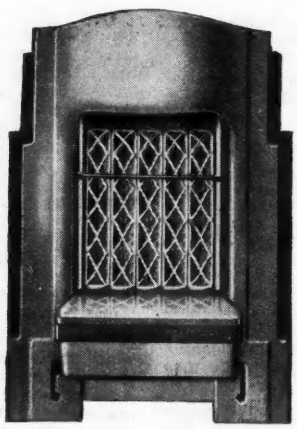

IN these days of scarcity of cast-iron types for permanent fixing the NEWSCREEN pressed-steel fire fills a decided need. Although light in weight, it is a thoroughly dependable gas-fire of strong build, and passes the "Lancet" test. Modern in design, the Newscreen is available in a pleasing selection of Duotone Colour finishes.

MAIN

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produced which, after purification, is dehydrogenated to give styrene:

$$C_6H_6 + C_2H_4 \longrightarrow C_6H_5C_2H_5 \longrightarrow C_6H_5CH{:}\,CH_2$$

The latter process is carried out at about 600° C. and atmospheric pressure in the presence of an excess of steam of 1.25 to 1.5 parts by weight. A complex catalyst consisting primarily of zinc oxide, but also containing oxides of aluminium, calcium, potassium and sometimes chromium, is used. The walls of the reaction vessel are lined with special metals (*e.g.*, copper-manganese) to prevent cracking effects. The styrene is purified by vacuum distillation.

Butadiene has been made in Germany from acetylene, and in the United States either from butanes or butenes made from cracking of petroleum oil, or from ethyl alcohol. It is clear that butadiene can be made from ethylene by conversion to alcohol followed by dehydration and dehydrogenation. It might be noted that in Russia the last two stages are carried out in a single stage by passage of the alcohol vapour over a mixture of aluminium and zinc oxides. It is evident that " Buna S " rubber could be made entirely from ethylene and benzene.

Styrene has been manufactured abroad for some years for use in the plastics industry, for example in making polystyrenes. Its present cost of manufacture in the United States, based on ethylene at £33 per ton and benzene at £12 per ton, is £37 per ton. In this country the price is about £110 per ton.

The American prices of a number of other materials are shown in Table 4:

TABLE 4.—*Prices of Chemicals in the U.S.A. (Converted to £ per ton at the* 1946 *Rate of Exchange)*

	£
Ethylene glycol	50 (1944)
Ethylene dichloride	44 (1944)
Ethylene chlorhydrin	450 (1939)
Ethyl chloride	100 (1944)
Methyl cellosolve	75 (1944)
Styrene	37 (1944)
Methyl chloride	200 (1944)
Methylene chloride	120 (1938)
Chloroform	120 (1944)
Carbon tetrachloride	25 (1945)
Paraldehyde	65 (1944)
Cellulose acetate	275 (1939)

Propylene

It is evident that if ethylene be separated from coal gas, propylene, C_3H_6, the next higher member of the olefine series, can be separated simultaneously. Propylene is much more reactive chemically than ethylene, and is particularly useful because it contains 3 carbon atoms and can readily be made to provide valuable compounds such as glycerol and acetone, which contain this number of atoms in the molecule. Although propylene is a gas at room temperature it can easily be liquefied by sufficiently increasing the pressure.

Alternative sources of propylene to coal gas in this country are refinery gases produced during cracking and reforming operations in the petroleum industry. When discussing ethylene it was mentioned that refinery gases are separated by fractionation under pressure so that hydrocarbons containing 1 or 2 carbon atoms are removed as a light fraction. The other fraction contains C_3 and C_4 hydrocarbons. These are made use of in America and, to a small extent, in this country as a portable gaseous fuel known as " Calor Gas," " Propagas," &c.

Conclusions

Potential demand depends on many factors, political and economic, outside the control of the carbonization industries. Some idea of the scale on which they might be produced can be obtained by examining the figures quoted for production during 1944 in the United States in Table 5:

TABLE 5.—*Production of Chemicals in the U.S.A.* (1944)

	Tons
Butadiene	145,000
Vinyl resins (about 50% polyvinylchloride)	80,000
Polymethyl methacrylate resins	16,000
Acetone (1945 figure)	175,000
Neoprene	52,000
Methyl chloride	12,149
Methylene chloride (1943 figure)... ...	3,369
Chloroform	4,373
Carbon tetrachloride	104,901
Freon 12	20,000
Ethylene glycol	101,225
Ethylene dichloride (1943 figure)... ...	57,847
Acetylene	178,300
	Gals.
Iso-propyl alcohol	75 mill.

The manufacture of these and allied substances may well become a major industrial undertaking in Britain, and that it is to the advantage of the Gas Industry not only to keep a close watch on developments, but to investigate in all possible ways the part that the Industry can play in this field. It is too early to put forward definite schemes, but unless consideration be given to possible ways in which the Gas Industry might play a part, it will not be able to take advantage of opportunities when they occur.

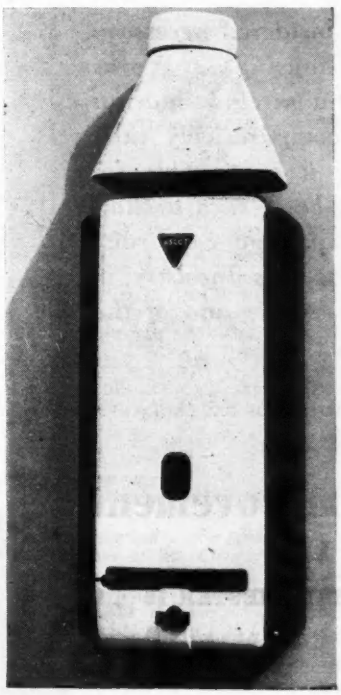
Present United States production of ethylene has been stated to be of the order of 2 mill. tons per annum. The total amount present in coal gas produced in this country is only a fraction of this (360,000 tons per annum). Further, in many cases, on account of location or scale of operation, separation of olefines alone could not be contemplated. It is possible, however, that at certain coke oven plants and at some of the large gas-works separation plants might be installed.

If a proportion of the methane in certain town gas supplies were being separated for storage against peak load requirements, as suggested by Egerton, olefines could be separated as one stage of this process. It might then be economic to treat quantites of gas which would be too small to treat for olefine separation only. Further, it is possible that all the methane actually separated, or which could be separated without altering the combustion characteristics of the residual gas unduly, would not be required during winter months, and it could then be subjected to chemical treatment.

Processes of complete gasification under investigation at present aim at providing flexibility in gas manufacture. It will be noted that both the hydrogenation of coal and methane synthesis are potentially capable of making a gas very rich in methane and may be able to provide large volumes of it. In this case it might well be economic to make use of a portion of the gas for chemical treatment.

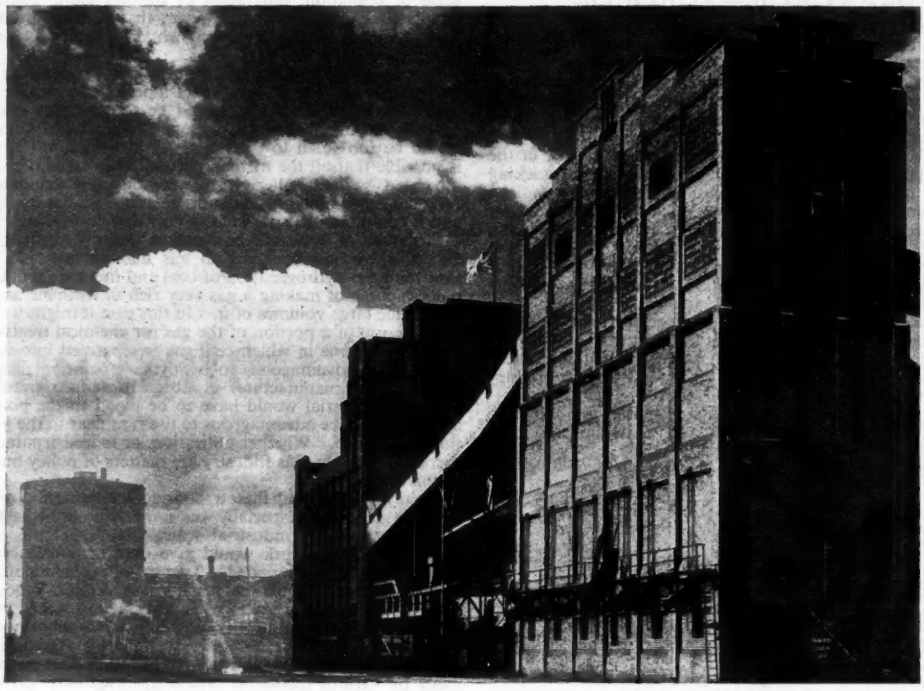
In any scheme in which coal gas is separated into its constituents, it would be advantageous to build the separation plant close to the point of gas manufacture, in order to reduce transmission costs. Separated material would have to be piped to the point of use, and again it would be advantageous to use it as near to the point of separation as possible. Whether utilization, or indeed separation, should be carried out by the Gas Industry are matters of policy outside the scope of this Paper.

Finally, it is clear that a considerable amount of experimental work is required, especially on a scale intermediate between the laboratory and the industrial scales, before definite plans could be drawn up. Such work would give data on which costs of various processes could be estimated. Two major points require examination. Firstly, a study should be made of separation processes up to at least a semi-technical scale; while liquefaction would be the principal method examined, adsorption and diffusion should not be neglected. Secondly, it would be necessary to know what substances it is permissible to have present and to what extent, in the treatment of various gases by various methods. These investigations, carried to a semi-technical scale, would *inter alia* provide chemical engineering data and practical experience on the technique of the various operations.



" Britain Can Make It "

This " Ascot " instantaneous multi-point gas water heater, type NEA. 32 T3, has been accepted by the Council of Industrial Design for the " Britain Can Make It " Exhibition. The exhibition is to be opened at the Victoria and Albert Museum next week. In addition to individual displays, about 20 rooms—kitchens, bathrooms, dining rooms, bedrooms, nurseries, living rooms—have been planned by individual designers in consultation with the Council. In the kitchens will be cookers and water heaters, washing machines, pots and pans, and specimens of the new labour-saving domestic machinery which is being developed at the present time. All the furnishings and equipment will be laid out as though for use. The decoration and furnishing of living rooms and bedrooms, the fittings and equipment of bathrooms and nurseries, will demonstrate that British manufacturers and designers have turned their skill from war to peace and are making great strides forward. The model illustrated represents a further stage between " Ascot " pre-war designs—now in maximum production—and the new range of instantaneous water heaters based on post-war developments for production in 1948. Type NEA. 32 T3 re-introduces the water-governed multi-point appliance for direct connexion to the main water supply and embodies improvements in design.

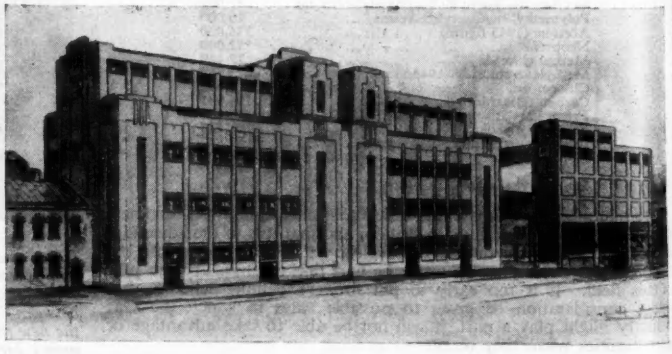


GLOVER-WEST *Vertical Retorts at* COVENTRY

"It is no longer considered necessary that the buildings housing Gas Works plant should be of a purely utilitarian character. For comparatively little extra expenditure it is possible for these buildings to be of such a character as to maintain and even raise the prestige of the Gas Industry in the eyes of the consumer and of the public as a whole."

COMMUNICATION No. 230—PROCEEDINGS OF THE INSTITUTION OF GAS ENGINEERS, 1939-40.

In this photograph of the fourth Installation of Glover-West Vertical Retorts at the Foleshill Works, Coventry, the coke storage hoppers with screening plant above are seen in the foreground. The retort house lies to the left. Space between is reserved for the duplication of the carbonizing plant. The project for the complete installation is sketched below.



West's Gas Improvement Co., Ltd.

Miles Platting, MANCHESTER 10

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London Office:
COLUMBIA HOUSE, ALDWYCH, W.C.2.

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COMPANY MEETING

Thomas De La Rue

In the course of his statement at the 49th Ordinary General Meeting of Thomas De La Rue & Co., Ltd., the Chairman, Mr. B. C. Westall, said:

I think it will be agreed that the accounts for the year show a satisfactory result. For the first time we have been able to publish a Consolidated Balance Sheet and Profit and Loss Account. These, together with the main Balance Sheet, provide a fair picture of the De La Rue Group. By far the greater proportion of the profits derive from the Security Printing Business. We expect, however, that the profits of the subsidiary companies will show a considerable improvement not in the current year, but in the year following. We found it necessary to make a substantial allocation for reconversion. The volume of orders in hand continues to be satisfactory.

De La Rue Plastics

For De La Rue Plastics, Ltd., the past year has been one of reconversion from wartime to peacetime operations. During the war the plant was almost wholly engaged on the production of munitions. Our hopes that we should be able to employ a number of pre-war moulds were not fulfilled because most of our customers required modifications of designs involving the making of new tools. This, of course, entailed a very considerable delay in getting the presses reconverted into commercial production. Furthermore, at the request of the Government, we had under the dispersal scheme sent up to our Scottish factory a considerable number of presses. We had hoped that at the termination of hostilities we should be able to obtain orders to keep these presses busy from local sources. For that purpose we set up an office in Glasgow, but after a protracted trial we arrived at the reluctant conclusion that we could not expect a sufficient volume of business to enable the plastics plant at Strathendry to operate economically. We therefore decided to remove this plant back to our Walthamstow factory. I would desire to emphasize that the process of reconversion is not yet complete and I anticipate that a further provision on this score will be necessary during the current year. The output of our Walthamstow factory is now improving and provided that adequate supplies of raw materials are available I think we may reasonably look for an improvement in our position at Walthamstow.

De La Rue Insulation

In the latter half of the past financial year we decided to put into force our plans for the expansion of De La Rue Insulation, Ltd. A factory is being built at Tynemouth which will house not only the existing laminated plant at Walthamstow, but the considerable new plant which is now being installed as well as the plant for the manufacture of Traffolyte, which we acquired from Metropolitan-Vickers, Ltd. We have also entered into an arrangement with the Formica Corporation of America for the manufacture of decorative boards. There is a very considerable demand for this material and when our new plant is in full production, which will not be before the end of the financial year, we may confidently look forward to a very considerable turnover in this new factory.

De La Rue Gas Development

During the past year we have also been able to proceed with our plans for the manufacture of gas appliances. De La Rue Gas Development, Ltd., have acquired the lease of a factory in Gateshead and a smaller one at Elstree. Prototypes of our heaters have been completed, tested, and passed forward for trial production. Plant and equipment for quantity production are now being erected. The staff has been enlarged and is engaged on the preparatory phases of production. This result has been brought about by the energy and wise planning of the Managing Director, Mr. Leopold Friedman, whose name is already a household word in the Gas Industry. Within a few months from now we hope to see a steady stream of gas appliances flowing from our factories and the name " De La Rue " on domestic heaters a familiar sight. The multi-point water-heater will be the first of our productions to come on the market. In the designing of the De La Rue multi-point heater the utmost care has been taken by Mr. Friedman and his staff to ensure that our product will be the most advanced design yet devised. Longer time than was originally anticipated has been spent on the construction of the prototype and on the testing of the apparatus. But the time so spent will be very fully justified by future results. The reports of gas companies on the trials made by them have been extremely encouraging. As for the sales of the " De La Rue " multi-point, for a long time to come they will be governed by our capacity to produce.

The prototype of the instantaneous boiling water heater is now complete and after completion of tests will also go into production. Apart from the technical aspect, special attention has been given to the aesthetic design. How far we have been successful the public will shortly be able to judge for themselves. The advantages of the instantaneous boiling water heater, both for domestic and other uses, are sufficiently obvious. We are hopeful that there will be a steady demand for this type of heater, which is complementary to the multi-point, for a long time to come.

The third item in our programme is the sink-heater. In addition to the appliances already mentioned, there is a field for a modern efficient sink-heater. This completes the three types of water-heating apparatus demanded by the public. Prototypes are also in hand for a gas grill and a gas copper. One of the features of all our appliances will be the employment of the " neat " gas jet. The " neat " jet enables the maximum heating value to be extracted from the minimum of gas.

In addition to the appliances outlined above we have also designed and made a prototype of a gas cooker. The cooker will be made of pressed steel and will contain new features which will, we believe, make it a distinct advance on any cooker hitherto produced. The manufacture of cookers, however, does not fit in very well, from a technical point of view, with our other appliances. We have, however, come to an arrangement with Friedman-Athill, Ltd., whereby they will manufacture the cookers and market them through a company in which we each own 50% of the shares. We hope that this arrangement will prove satisfactory to both parties. During the past year considerable difficulty was experienced by Thomas Potterton (Heating Engineers), Ltd., in obtaining iron castings. As a result the Board, primarily with the object of ensuring an adequate supply of castings, purchased the fixed assets, stock and goodwill of the Emscote Foundry Company, Ltd. It was found convenient to operate the foundry as a branch of De La Rue Gas Development, Ltd. Apart from the manufacture of castings, the foundry is making and selling a gas cooker of a less expensive type than the " neat " cooker to which I have referred. New plant has been added to the foundry, which is being modernized. Already production has largely increased both for castings and for gas cookers. We are not without hope that in due course the branch will prove remunerative.

Our photograph is of a tower wagon which has been made up to the specifications of the Coventry Gas Department. The vehicle is a 50 cwt. Crompton Parkinson " Morrison Electricar " and is fitted with a three-tier elevator—maximum extending height 25 ft. with full circuit turntable. The reasons for purchasing this type of vehicle were economy considerations both from a taxation and from a running point of view. The latter factor is a particularly desirable aim with this type of maintenance vehicle as there is no likelihood of fuel usage while standing. A 30 mile running limit is possible and the batteries are on charge during night standing time. The Department has 500 suspension lamps and adequate maintenance is effected.

Rope Talks, No. 18 in the series issued by British Ropes, Ltd., has reached this office. This 24-page booklet is conspicuous for its many fine photographs and contains articles on such subjects as mine sweeping, the Long Range Desert Patrol, Britain's Countryside at War, &c.